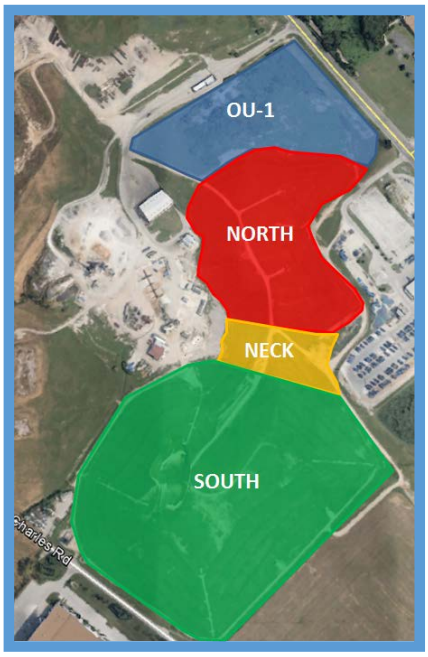
**Bridgeton Landfill Data Review Update**

*Primarily Reflects Data and Documents Published on MDNR's Webpage for data collected in April 2016*

## Introductory Remarks




The ORD Engineering Technical Support Center (ETSC) and their subcontractor reviewed data and reports at the Missouri Department of Natural Resources (MDNR) Bridgeton Landfill website. The purpose of the review was to examine available reported data collected at the landfill gas extraction wells (GEWs), gas interceptor wells (GIWs), and temperature monitoring probes (TMPs) to assess the presence and progression of any subsurface oxidation event/heat-generating event occurring in the South Quarry, North Quarry or the adjoining "Neck" area (*see figure on right for an approximate depiction of these areas and the adjacent Westlake Landfill OU-1 cell*). The shaded areas shown in the figure are intended to provide a quick reference to different areas of interest. This report analyzes data primarily collected in April 2016.

The closure of the South Quarry and North Quarry landfill cells was approved by MDNR in 2008 and 2010, respectively. The landfill cells were closed with a 2-ft thick clay cap (with hydraulic conductivity $< 1 \times 10^{-5}$ cm/sec) overlain by a 1-ft thick vegetative soil layer. An ethylene vinyl alcohol (EVOH) flexible membrane cap was placed over the South Quarry, Neck Area, and a portion of the North Quarry in 2013 and 2014. Work was initiated in the South Quarry at various times in 2014 and 2015 to repair slopes that had subsided. A North Quarry cap enhancement project (approved by MDNR on 27 January 2016) was recently initiated, which includes installing a flexible membrane liner between the edge of the EVOH liner and the perimeter road, along with associated stormwater management and gas management infrastructure. The installation of 15 new GEWs in the South Quarry began in March but has yet to be completed. Additional information on this plan is available on the MDNR website (link above).

This document provides a summary and discussion of data collected in North Quarry, Neck Area, and South Quarry of the landfill. Observations on the flare data are also provided below:

- The average flow rate of methane ($CH_4$) (242 standard cubic feet per minute (scfm)) from the flare was less than in March 2016 (292 scfm) and the flow rate of carbon dioxide ($CO_2$) (1,056 scfm) was slightly more than in March (1,051 scfm). The balance gas flow rate of 1,185 scfm in April was less than in March (1,269 scfm).
- The average total flare flow rate of 2,700 scfm in April was less than the average total flare flow rate in March (2,869 scfm).

Flare data are subject to further examination, as indicated in prior monthly reports due to identified issues with the calibration of the flow measurement system implemented at the site.

However, it is our understanding that flow data from individual GEWs and GIWs were accurate throughout 2015 and into 2016.

## North Quarry

*Temperature*

**April measurements showed one well (GEW-03) that had a temperature increase in the beginning of the month that remained steady for rest of the month.** The remaining wells exhibited mostly steady temperatures when compared to March data. The maximum temperature measured in North Quarry wells was 125 °F (GEW-02).

Data from several TMPs in the North Quarry (TMP-16 through -18 and -21 through -29) were examined, and the observed temperatures were generally steady in April, with no substantial temperature increases observed, similar to observations in March. TMP-21 and -28 showed temperature declines at a single depth of > 2 °F.

**Three TMPs (-16, -17, and -25) had at least one depth with a measured temperature > 160 °F, this is the same as seen in February and March.** TMP-27 also showed temperature > 160 °F in one measurement at the 80-ft depth. Additionally, TMP-27 had a temperature just below 160 °F at the 100-ft depth. These levels are generally consistent with historical values, which have not exceeded 160 °F. **Temperatures > 160 °F were observed at two depths in TMP-25, but observed temperatures were less than historical highs at these depths (60 ft and 80 ft).**

*Collected Gas Quality*

**April data showed similar historical trends with respect to balance gas, with some wells showing an elevated balance gas concentration. A maximum balance concentration of 35% was measured at GEW-05.** Measured vacuum pressure increased slightly for some wells and the remaining wells remained steady, with the majority of wells exhibiting a low or no vacuum (either < 2" water column [w.c.], or positive pressure) for multiple measurements taken throughout the month. Laboratory data suggest that elevated balance gas concentrations were mostly comprised of $N_2$. Similar to March measurements, nearly all elevated balance gas measurements were accompanied by a low $O_2$ concentration (< 2%), suggesting possible air intrusion in the wells with elevated nitrogen ($N_2$). The remaining wells exhibited conditions typical of normal anaerobic decomposition.

*Settlement*

**No settlement data were collected for the North Quarry in April.**

## Neck Area

*Temperature*

**TMP measurements were mostly stable when compared to March data except for TMP-2, -6, and -11.** TMP-2 and -6 exhibited increased temperatures of > 2 °F at shallow depths. However, TMP-11 exhibited one of the highest temperature increases at deeper depths. An average temperature increase of 9.3 °F and 13.8 °F from March was observed at 196-ft and 216-ft depth, respectively. The remaining TMPs showed a mostly steady trend with temperature changes < 2 °F.

**April GIW data showed steady temperatures with an increased temperature measurement taken at the very last reading which corresponded with the lowest pressure reading of the month**. Temperatures remained < 100 °F for all GIWs retrofitted with the heat extraction system (HES). Most GIWs exhibited strong vacuum at some point during the month, although not all GIWs showed a consistently strong vacuum (e.g., GIW-2 and GIW-3). Three GIWs (-9, -11, and -12) consistently exhibited low vacuum throughout the month.

**GEWs exhibited mostly steady temperature trends with increased temperatures in some measurements in April.** Applied vacuum remained mostly steady with a few fluctuating measurements that did not appear to drastically affect temperatures. GEW-10 continued to have a large applied vacuum (generally > 15" w.c.), but subsequent increases in temperature were consistent with historical levels.

*HES Evaluation*

TMPs installed adjacent to GIWs retrofitted with the HES (cooling loop system) were examined and compared to March data. The April data displayed mostly steady or slightly decreasing temperatures at certain depths. The TMP-5 HES series TMPs showed mostly steady trends except for TMP-5-5S, which showed varying temperatures (> 2 °F) at 20 ft and 100 ft depths, respectively. TMP 5-5N also showed a decrease of > 2 °F at the 60-ft depth. At TMP-10-5S, the average temperatures of the current month were lower than the previous months at four depths, with the largest decline at the 20-ft depth of approximately 2.8 °F. The 140-ft depth at TMP-20 continued showing a temperature increase (approximately 5 °F, similar to the month-over-month increase seen from November 2015 to March 2016).

Similar to March, the TMPs continued showing higher temperatures than the adjacent GIWs, and the TMPs closer to the GIW generally had lower temperatures than those farther from the GIWs, indicating a mostly localized cooling effect from the HES.

*Collected Gas Quality*

**Four (GEW-38, -109, -110, -56R) of 14 GEWs exhibited elevated balance gas concentrations (ranging from about 30% and 65%) at least once in April. $O_2$ concentrations in these wells were all low except at two wells (GEW-38 and -110) in comparison to the amount of balance gas present, which suggests possible air intrusion.** The other wells generally exhibited anaerobic conditions with balance gas concentrations < 10% and $O_2$ < 1%.

**All 13 GIWs exhibited elevated concentrations of balance gas (ranging between about 13% and 78%) and/or $CO_2$ (between approximately 1% and 70%).** Elevated balance gas concentrations were observed during the entire month and the majority of GIWs had measured concentrations > 30%, with a maximum of approximately 78% at GIW-12. Some GIWs showed elevated balance gas and elevated $O_2$, suggesting potential air intrusion at the well (GIW-2, -3, -4, -7, -9, -12), while several GIWs (GIW-1, -5, -6, -8, -10, -11, -13) had elevated balance gas but low $O_2$. This suggests possible air intrusion into the waste. $CH_4$ concentrations were generally < 20% for each GIWs.

*Settlement*

Limited elevation points were measured in the Neck Area, thus no assessment of settlement rates in the Neck Area is made here.

**South Quarry**

*Temperature*

- **No GEWs with data had temperatures at or > 200 °F; 30 wells had measured temperatures ranging from 140 °F to 200 °F; 23 wells had measured temperatures < 100 °F.**
- **56 wells maintained an applied vacuum of at least 2″ w.c. for the whole month.**
- **Two TMPs (TMP-31 and TMP-32) were examined. Generally, temperatures were steady or slightly increasing, with notable increases at the 160-ft depth at TMP-31 and the 200-ft depth at TMP-32.**

*Collected Gas Quality*

**No GEWs in the South Quarry exhibited gas concentrations consistent with anaerobic waste decomposition conditions.**

*Settlement*

The maximum point-to-point surface settlement depth in April was 1.35 ft, which is the same maximum settlement depth as in March. The volumetric change in the landfill, computed as the difference in surfaces created by individual elevation points in April and March, was estimated using a computer-aided design program. The analysis showed a volume decrease of approximately 18,000 cubic yards ($yd^3$) from March to April, which is more than the estimated 14,000 $yd^3$ volume loss from February to March. This value should be considered as an estimate since there were some settlement points missing from this month's data and details on surface filling or removal activities were not available in the site's monthly report narrative.